means for routing data packets within a virtual private network;

means for generating and sending a probe message through a communication channel of the virtual private network; and

an enclosure that houses said means for routing and said means for preparing and sending.

23. (Amended) A method for collecting network performance statistics, comprising the steps of:

generating a probe message with a probing router;

sending said probe message via said probing router over a communication channel; and

measuring a propagation time for said probe message to reach a predetermined location.

REMARKS

By this amendment, claims 1-23 are pending, in which claims 1-9, and 12-23 are amended. Thus 23 claims are pending, of which 5 claims are independent. Care was exercised to avoid the introduction of new matter (see, e.g., Specification, p: ¶ [27]:5-8).

In the present Office Action, (i) claims 20-21 were objected to under 37 C.F.R. § 1.75(c) as failing to further limit the claimed invention; (ii) claims 12 and 19-21 were rejected under 35 U.S.C. § 112, second paragraph, based on a finding of indefiniteness; (iii) claims 9-20, 22 and 23 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Mirek et al.* (US 5,878,032) in view of *Diebboll et al.* (US 5,886,643); (iv) claim 21 was rejected under 35 U.S.C. § 103(a) as being unpatentable over *Mirek et al.* and *Diebboll et al.* in view of allegedly acknowledged prior art; (v) claims 1, 2, 4 and 5 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Smith et al.* (US 5,930,257) in view of *Mirek et al.*; (vi) claims 3, 6 and 7 were rejected under 35

U.S.C. § 103(a) as being unpatentable over *Smith et al.* and *Mirek et al.* in view of *Diebboll et al.*; and (vii) claim 8 was rejected under 35 U.S.C. § 103(a) as being unpatentable over *Smith et al.* and *Mirek et al.* and *Diebboll et al.* in view of allegedly acknowledged prior art.

In response to the objection to claims 20-21 under 37 C.F.R. § 1.75(c) and the rejection of claims 12 and 19-21 under 35 U.S.C. § 112, second paragraph, claims 12 and 19-21 have been amended to correct the noted and discovered informalities, without the introduction of new matter. In addition, claims 1-9, and 12-23 have been amended to correct discovered informalities, without the introduction of new matter (see, e.g., Specification, ¶ [27]:5-8). All of the pending claims are in compliance with 35 U.S.C. § 112 and no further rejection on such basis is anticipated. If, however, the Examiner disagrees, the Examiner is invited to contact the undersigned attorney, who will be happy to work with the Examiner in a joint effort to derive mutually satisfactory claim language.

The rejection of claims 1-23 is respectfully traversed because *Mirek et al.*, *Smith et al.*, *Diebboll et al.* and the allegedly acknowledged prior art, taken alone or in combination, fail to teach or suggest the limitations of the claims. For example, independent claim 1 (emphasis added) recites:

> **A probing router**, comprising:
> **a probe mechanism configured to generate and send a probe message** through said communication network port to the communication network at a time T1 over a communication channel;

independent claim 9 (emphasis added) recites:

> **generating a probe message via a source probing router**; and
> **sending said probe message via said source probing router** over a communication channel;

independent claim 14 (emphasis added) recites:

> **a probing router configured to generate and send a probe message** and prepare performance statistics information;

independent claim 22 (emphasis added) recites:

> **A probing router**, comprising:
> **means for generating and sending a probe message** through a communication channel of the virtual private network; and

independent claim 23 (emphasis added) recites:

> **generating a probe message with a probing router;**
> **sending said probe message via said probing router** over a communication channel.

The inventions of independent claims 1, 9, 14, 22 and 23 recognize and address problems discovered by Applicants with respect to Background Art probing techniques, such as described with respect to Background Art Fig. 1 in Applicants' Specification. Specifically, as described at ¶ [9] and [13] (emphasis added):

> [9] The network 17 includes routers 9 that are interconnected by way of lines 4. Likewise, routers 5 are interconnected by lines 2. Interconnections between routers 9 and 5 are not shown to help illustrate the point that **there are different physical paths that a packet may follow through the network 17 when traveling from the source probe 1 to the destination probe 3**. The actual path that a particular packet follows (i.e., an "in-band" path, or channel) will be influenced by the source/destination pair included in its header. **Because the source/destination pair will vary depending which device is generating the packet and which device is receiving the packet, packets handled by the source router 7 and ultimately headed through destination router 13 may follow different routes through the network 17**. Routers 5 and 9 in the network include routing tables that direct how certain packets are routed, and thus these routers may handle one packet from the source probe 1, different from a packet generated by a terminal on the source LAN

performance management ATM OAM cells, or performance management frame relay frames. These cells or frames contain a timestamp (T1-T4) indicating the time a cell or frame is sent and a delay value indicating a difference between reception and transmission times of the cell or frame. Abstract and Fig. 1 of *Mirek et al.*

However, *Mirek et al.* is no better that the Background Art probing techniques described with respect to Background Art Fig. 1 in Applicants' Specification and the present Office Acknowledges that *Mirek et al.* "does not explicitly disclose that node A is a router" (Office Action p. 3, ¶ 4). Moreover, *Mirek et al.* fails to recognize or address the noted problems with the Background Art probing techniques, much less teach or suggest a probing router that generates and sends a probe message, as required by independent claims 1, 9, 14, 22 and 23.

Smith et al., directed to a network router 200, is also deficient in the above respect. The present Office Acknowledges that *Smith et al.* "does not explicitly disclose a probing mechanism, as part of the router" (Office Action, p. 6:¶ 6). In addition, *Smith et al.* also fails to recognize or address the noted problems with the Background Art probing techniques and also fails to teach or suggest a probing router that generates and sends a probe message, as required by independent claims 1, 9, 14, 22 and 23.

Thus, the rejection of independent claim 1, under 35 U.S.C. § 103(a), as being unpatentable over *Smith et al.* in view of *Mirek et al.*, is traversed, since neither *Smith et al.* nor *Mirek et al.* recognize or address the noted problems with the Background Art probing techniques nor teach or suggest a probing router that generates and sends a probe message, as required by independent claim 1. The present Office Action attempts to cure such deficiency by arguing that "it would have been obvious … to include the probing mechanism taught by Mirek in the Smith router to simplify design" (Office Action, p. 6:¶ 6)

However, not only is such assertion conclusory and clearly based on impermissible hindsight, such assertion fails to provide adequate evidence of motivation for modifying *Smith et al.* in view of *Mirek et al.* Specifically, there are numerous ways to "simplify" a router "design," such as by using ASICs, etc., and the present Office Action has failed to provide adequate evidence of motivation for modifying *Smith et al.* to include the probing mechanism of *Mirek et al.* to simplify *Smith et al.'s* router design, out of the numerous ways to simplify a router design, such as by using ASICs, etc.

The present Office Action also attempts to cure the noted deficiencies with *Smith et al.* and/or *Mirek et al.* by applying supposed teachings from *Diebboll et al.* *Diebboll et al.* is directed to a method and apparatus for discovering network topology, including processing data from a plurality of probes (20), which monitor traffic over a network, which includes a plurality of segments (10) to which are connected a plurality of nodes (12) and routers (14). Abstract and Fig. 1.

However, *Diebboll et al.* also fails to recognize or address the noted problems with the Background Art probing techniques and also fails to teach or suggest a probing router that **generates and sends a probe message**, as required by independent claims 1, 9, 14, 22 and 23 (emphasis added). As disclosed by *Diebboll et al.*, at col. 4:43-44, (emphasis added) "[a] probe is meant to include any machine on a network that **collects and stores information about traffic** it has seen." Accordingly, the probes of *Diebboll et al.* are not disclosed to generate and send probe messages, as required by independent claims 1, 9, 14, 22 and 23, since they merely collect and store information.

Nonetheless, the present Office Action, at p. 3:¶ 4, asserts that "Diebboll teaches that a probe such as node A could be part of a router," citing col. 4:45-48 of *Diebboll et al.* However,

as noted above, the probe of *Diebboll et al.* does not generate and send probe messages, as arguably disclosed by the node A of *Mirek et al.* Accordingly, neither *Mirek et al.*, *Smith et al.* nor *Diebboll et al.*, recognize or address the noted problems with the Background Art probing techniques nor teach or suggest a probing router that **generates and sends a probe message**, as required by independent claims 1, 9, 14, 22 and 23 (emphasis added).

The present Office Action also attempts to justify a combination with *Diebboll et al.* by arguing that "[c]ombining hardware **could** simplify design and reduce cost" (Office Action, p. 3:¶ 4, emphasis). However, not only is such assertion conclusory, clearly based on impermissible hindsight, and uncertain (**could?!**), such assertion fails to provide adequate evidence of motivation for modifying *Mirek et al.* and/or *Smith et al.* in view of *Diebboll et al.* Specifically, there are numerous ways to "simplify design and reduce cost," such as by using ASICs, etc., and the present Office Action has failed to provide adequate evidence of motivation for modifying *Mirek et al.* and/or *Smith et al.* based on *Diebboll et al.* to simplify design and reduce cost, out of the numerous ways to simplify a design and reduce cost, such as by using ASICs, etc.

The allegedly acknowledged prior art was not a basis for the rejection of independent claims 1, 9, 14, 22 and 23 and nonetheless fails to teach or suggest a probing router that generates and sends a probe message, as required by independent claims 1, 9, 14, 22 and 23. Accordingly, *Mirek et al.*, *Smith et al.*, *Diebboll et al.* and the allegedly acknowledged prior art, taken alone or in combination, fail to teach or suggest the noted limitations.

The portions of the Applied References cited in the present Office Action do not support the rejections. For example, as noted above, *Mirek et al.* and *Smith et al.*, taken alone or in combination, not only fail to recognize or address the noted problems with the Background Art probing techniques, they fail to teach or suggest a probing router that generates and sends a probe

message, as required by independent claim 1. Similarly, although col. 4:45-48 of *Diebboll et al.* may disclose that the *Diebboll et al.* probe may be part of a router, the *Diebboll et al.* probe does not generate and send a probe message, as required by independent claims 1, 9, 14, 22 and 23 (emphasis added).

In addition, the Specification, pages 12-19, was amended to correct mis-numbered paragraphs therein. No new matter is introduced.

Therefore, the present application, as amended, overcomes the objections and rejections of record and is in condition for allowance. Favorable consideration is respectfully requested. If any unresolved issues remain, the Examiner is invited to contact the undersigned attorney so that such issues may be resolved as expeditiously as possible.

Respectfully Submitted,

DITTHAVONG & CARLSON, P.C.

3/8/02
Date

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APPENDIX

Please amend the Specification, pages 12-19, to correct mis-numbered paragraphs therein, as follows:

Page 12, mis-numbered paragraphs [1]-[4]:

--[37] The characteristics of the latency logs are as follows:

File Name: latency.log.<timestamp when file closed>.gz

[38] Directory Structure on the Monitoring System Server:

$VPNLOGS/vpnlogs-<collector process pid>-<sequenctial counter>/<probe hostname>/<vpn name>

[39] File Characteristics: ASCII, colon delimited fields, compressed with gzip, lines beginning with "#" are comment fields, All timestamps are UTC, a "$" character is output on the last line to terminate the file.

[40] The file contents and data structure saved in memory of each record saved in the VPN probing router is as follows:--;

Pages 13-19, mis-numbered paragraphs [1]-[21]:

--[41] The probing routers may generate SNMP Traps when the number of packets lost in a predetermined amount of time exceeds a predetermined threshold, and if the probe latency is measured as exceeding a predetermined time.

[42] SLA statistical data compiled by the probe poller processor 223 is provided to the SLA reporting system 225. The SLA reporting system 225 provides to a customer a condensed aggregation of data collected by the probe poller processor 223 so that the customer may review whether the SLA was complied with during the reporting interval. In one embodiment, the SLA system 225 aggregates the data on a month-by-month basis and provides the data via a server on an Internet web-site for review by customers of the VPN. Alternatively, a computer and printer

reply probe message, and R_1 is the time at which the probe message was received by the destination VPN probing router 203. Accordingly, the remote latency R_L is the difference between these two times and measures the amount of time that was required by the destination VPN probing router 203 to generate and send the reply probe message after receiving the probe message. The reply probe message also includes the source time stamp T1 321b. The source probing router 207 then receives the reply probe message at time T2.

[48] Figure 4 represents the internal components of a source VPN probing router according to the present invention. Within a housing 401, the probing router includes a data bus 403 that interconnects a processor 405 with other components connected to the bus 403. In particular, the processor 405 executes computer readable instructions saved on ROM 409 to implement both a routing engine 477 as well as the programmable probe device 407.

[49] The main memory 408 is a RAM that receives software settable parameters sent from the QVPN builder 227 (Fig. 2) for setting the probing parameters that would be executed by the programmable probe device 407. The programmable probe device 407 is shown to be internal to the processor 405, which is the case when it is implemented only in software, but may also be a separate component that communications with the other components by the bus, or other signal relaying mechanism, such as a local bus or optical link. The programmable probe device includes a timer that generates a probe message after a predetermined time has elapsed since the last probe message was sent. The programmable probe device 407 either maintains internally thereto, or retrieves from main memory 408, a polling interval parameter that was set by the QVPN builder 227. Furthermore, the programmable probe device 407 also receives an indication from the QVPN builder 227 which destination VPN probing routers the source VPN is to communicate with so that tunnels may be established therebetween.

[50] A storage device 410 is also a RAM and is used to hold information regarding round trip delay and whether packets are dropped. This information is later sent to the probe poller processor 223, either on demand from the probe poller processor 223 or at periodic intervals as a software settable parameter and saved in main memory 408. The packet grouping logic 417 and envelope packet logic 419 cooperate to form IP packets for assessing whether received packets are to be routed to a device connected to the router, or not. Likewise, the packet grouping logic 417 and envelope packet logic 419 cooperate to form packets for sending over the IP network 417 by way of the input/output unit 415. A buffer unit 413 serves as a buffer for saving and

holding message traffic when the processor 405 is busy (for inbound messages) or for sending packets when either the input/output unit 415 is busy or the IP network 417 is busy. The input/output 415 connects by way of a bus 421 to the IP network 417. A local source terminal 450 also connects to the input/output unit 415 for local [accessability] accessibility to the router. The IP network 417 and source terminal 450 connect through ports (or connectors) to the housing 401.

[51] Figure 5 is a flowchart showing a process flow for collecting SLA statistics over the VPN. The process begins in step 501 where an inquiry is made regarding whether a predetermined time period has elapsed since the source VPN probing router has sent the last probe message. If the response to the inquiry is negative, the inquiry is made again until the time period has in fact elapsed. Once the response to the inquiry is affirmative, the process proceeds to step 503 where the source VPN probing router sends a polling packet to the destination VPN probing router 203. The polling packet (probe message) optionally includes a time stamp T1 therein. Alternatively, the source VPN probing router simply stores in memory the time at which the polling packet has been sent, thus not notifying the destination VPN probing router when the message was in fact sent.

[52] After step 503, the process proceeds to step 505 where the probe message is received at a time R_1 at the destination VPN probing router. The destination VPN probing router then prepares a reply probe message and sends the reply probe message at a time R_2 such that the remote latency (i.e., turn-around time of the destination VPN probing router) is given by $R_L = R_2 - R_1$. The process then proceeds to step 507 where the remote latency (or processing delay) R_L is inserted in the reply probe message and the reply probe message is then sent.

[53] After step S507, the process proceeds to step S509 where the programmable probe device 407 (Figure 4) compares the amount of time between when the probe message was sent (T1) and when (if at all) a reply probe message is received (T2). In step 509 if it is determined that the difference between T2 and T1 is greater than a predetermined amount (a software settable parameter) then it is determined that the packet (probe message) was dropped. If the packet was dropped, the process proceeds to step S511 where an indication is saved in memory 410 (Figure 4), or sent directly to the probe poller processor 223 (Figure 2) indicating that a packet was dropped. The process then proceeds to step S519.

received and the process then proceeds to step S515 where a round-trip time R_{tt} is calculated. The calculation for round-trip time is determined as $R_{tt} = (T_2 - T_1) - R_L$. The process then proceeds to step S517 where R_{tt} is stored in memory at the probing router, although alternatively the data may be sent directly to the probe poller processor 223 at the VPNOC 221.

[55] The probe poller processor 223 gathers information from the respective probing routers in the VPN and calculates average round-trip time, R_{tt}, availability, and packet loss rate for each tunnel as well as for the entire VPN. After having collected these SLA statistics, the process proceeds to step S521 where an inquiry is made regarding whether an SLA performance is judged to be below a required level, typically the service level agreement threshold levels. If the response to the inquiry in step 521 is negative, the process repeats so as to maintain a SLA statistical retrieval monitoring process. On the other hand, if the response to the inquiry in step 521 is affirmative, the process proceeds to step 523 where corrective action is taken on the network resources. This may include dispatching a trouble-shooting technician to identify a source of the problem or adjusting the software settable parameters in the probing router, so as to be less stringent on the service level requirements imposed on the network. The corrective action may also include providing a refund to a client, if the service level agreement statistics were in fact below the required level. After step 523 the process then repeats so as to continue the SLA statistic collection and analysis operation.

[56] Figure 6 is a flowchart of a process for automatically and remotely configuring a VPN architecture according to customer-specified requirements. The process begins in step S601 where the QVPN builder 227 is provided with VPN topology configuration information, which identifies the different VPN nodes that will be used in the customer-specified VPN. The process then proceeds to step S603 where the probing routers are either manually assigned a polling interval, or a default setting is included, such as two minute intervals. The process then proceeds to step 605 where the QVPN builder 227 sends configuration messages to the respective probing routers by way of the network 217. The probing routers then set the software settable parameters for the programmable probe device 407 either in the main memory 408 or in the programmable probe device itself.

[57] After step S605 the process proceeds to step S607, where the programmable probe device 407 (Figure 4), causes the SLA statistical data that is saved in the storage device 410 to be sent to the probe poller processor 223 (Figure 2). The probe poller processor 223 creates a database in

the probe polling processor and holds the data therein for calculation and distillation of SLA statistical data.

[58] In the event that changes are required in the network, the process proceeds to step 609 where the QVPN builder 227 dispatches a "configuration" message to respective of the programmable probe devices in the probing routers. The configuration messages include the software settable parameters used by the probing routers to determine the polling interval, dropped packet threshold decision time, and other parameters such as particular node addresses to which to communicate with in determining round-trip time for packet transmission. Once the configuration messages are dispatched, the process proceeds to step S611 where the configuration messages are received at each of the programmable probe devices and the programmable probe devices employ the parameters contained therein to perform probing operations at the polling interval identified in the configuration message. Subsequently the configuration process ends.

[59] The processes and control mechanisms set forth in the present description may be implemented using conventional general purpose microprocessors in the routers that are programmed according to the teachings of the present specification, as will be appreciated to those skilled in the relevant art(s). Appropriate software coding can readily be prepared by skilled programmers based on the teachings of the present disclosure, as will also be apparent to those skilled in the relevant art(s).

[60] The present invention thus also includes a computer-based product that may be hosted on a storage medium and include instructions that can be used to program a computer to perform a process in accordance with the present invention. The storage medium may include, but is not limited to, any type of disk including floppy disks, optical disks, CD-ROMs, magneto-optical disks, ROMs, RAMs, EPROMs, EEPROMs, flash memory, magneto or optical cards, or any type of media suitable for storing electronic instructions.--.

Please amend claims 1-9, and 12-23, as follows:

--1. (Amended) A probing router, comprising:

[a bus;]

a routing engine [coupled to the bus and] configured to forward packets to a communications network[;] <u>via</u> a communication network port [coupled to the bus and configured to connect to a communication network and transmit a probe message and the packets therethrough]; and

a probe mechanism configured to generate and send [the] <u>a</u> probe message through said communication network port to the communication network at a time T1[, said probe mechanism sending the probe message] over [an in-band] <u>a</u> communication channel.

2. (Amended) The probing router of Claim 1, wherein[:]said probe mechanism [being] <u>is</u> configured to receive a reply probe message at a second time, T2, sent by a destination router in response to receiving said probe message with a remote latency indicator therein so that service level agreement characteristics may subsequently be derived by comparing T1, T2 and the remote latency indicator.

3. (Amended) The probing router of Claim 2, further comprising:

a memory,

wherein the probe mechanism [being] <u>is</u> configured to identify and store in the memory the service level agreement characteristics.

4. (Amended) The probing router of Claim 1, wherein[:]said [in-band] <u>communication</u> channel [being] <u>includes</u> a tunnel channel in a virtual private network.

5. (Amended) The probing router of Claim 2, wherein[:]said reply probe message [including] <u>includes</u> a data field configured to hold the remote latency indicator that represents an amount of time between when said destination router received said probe message and when said destination router sent said reply probe message.

6. (Amended) The probing router of Claim 1, wherein[:]a polling interval at which said probe mechanism sends said probe message [being] comprises a remotely programmable setting.

7. (Amended) The probing router of Claim 3, wherein[:]said probe mechanism [being] is configured to send at least one of T1, T2, and the remote latency indicator to a probe poller device that calculates service level agreement statistics.

8. (Amended) The probing router of Claim 7, wherein[:] said probe mechanism [being] is configured to calculate service level agreement statistics based on T1, T2, and the remote latency, said service level agreement statistics including at least one of a network availability statistic and a packet loss rate.

9. (Amended) A computer-readable medium carrying one or more sequences of one or more instructions for sending a probe message, the one or more sequences of one or more instructions including instructions which, when executed by one or more processors, cause the one or more processors to perform the steps of:

[(a) preparing] generating a probe message via a source probing router; and

[(b)] sending said probe message via said source probing router over [an in-band] a communication channel.

12. (Amended) The computer-readable medium of Claim 11, wherein when the one or more instructions are executed by the one or more processors cause the one or more processors to further perform the step of:

calculating service level agreement statistics associated with the [in-band] communication channel being part of [the] a virtual private communication network from T1, T2 and said remote latency indicator.

13. (Amended) The computer-readable medium of Claim 9, wherein said [in-band] communication channel [being an in-band] includes a communication channel of a virtual private network.

14. (Amended) A communication system for gathering traffic statistics, comprising:

a probing router configured to generate and send a probe message and prepare performance statistics information;

a probe poller processor configured to receive performance statistics information collected by a probing router that generates and sends a probe message through [an in-band] a communication channel; and

a reporting mechanism coupled to said probe poller processor and configured to present a compilation of said performance statistics information for comparison against performance thresholds of a service level agreement.

15. (Amended) The system of Claim 14, wherein said [in-band] communication channel [being] is included in a virtual private network.

16. (Amended) The system of Claim 14, wherein said probing router [being] is included within a customer premise.

17. (Amended) The system of Claim 14, wherein said reporting mechanism [being] is configured to report said performance statistics information in at least one of a printed form and a graphically displayed form.

18. (Amended) The system of Claim 14, wherein said reporting mechanism [being] is configured to report said performance statistics on an Internet web site.

19. (Amended) The system of Claim 14, further comprising:

a virtual private network builder configured to receive topology information regarding an assignment of probing routers to [the] <u>a</u> virtual private network and produce a control signal to be distributed to respective probing routers, said probing router being one of said probing routers.

20. (Amended) The [virtual private network operation center] <u>system</u> of Claim 19, wherein[:] said control signal [including] <u>includes</u> a polling interval indicator that sets a polling interval at which said probing router sends said probe message.

21. (Amended) The [virtual private network operation center] <u>system</u> of Claim 14, wherein[:] said probe poller processor [being] <u>is</u> configured to calculate at least one of an availability and a packet loss rate of said in-band communication channel from said performance statistics information.

22. (Amended) A probing router, comprising:

means for routing data packets within a virtual private network;

means for [preparing] <u>generating</u> and sending a probe message through [an in-band] <u>a communication</u> channel of the virtual private network; and

an enclosure that houses said means for routing and said means for preparing and sending.

23. (Amended) A method for collecting network performance statistics, comprising the steps of:

[(a) preparing] <u>generating</u> a probe message with a probing router;

[(b)] sending said probe message <u>via said probing router</u> over [an in-band] <u>a</u> communication channel; and

[(c)] measuring a propagation time for said probe message to reach a predetermined location.--.